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ABSTRACT

The Fry Graph for Estimating Readability (Extended) and George Magginnis' formula for passages shorter than 100 words were used in an investigation of the reading levels of 18 mathematics textbooks produced for grades one through six by three major publishers. The results indicated that the readability levels of the textbooks were inaccurate. Few books were appropriate for the average child and few were for the slow or low-achieving child. None of the third grade books and only one fifth grade book were on level. Two other fifth grade books had seventh grade readability levels. (FL)

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A STUDY TO DETERMINE THE READING LEVELS OF THE MATH TEXTS IN GRADES 1 THROUGH 6 PUBLISHED BY HOLT, REINHART AND WINSTON, SCOTT, FORESMAN AND FIELD EDUCATION PUBLISHERS.

BY

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Abstract

This study investigated the reading levels of math textbooks in grades 1 through 6, published by Holt, Reinhart and Winston, Scott, Foresman and Field Education Publishers.

The Fry Graph for Estimating Readability-Extended was used, along with Magginnis' formula for passages shorter than 100 words.

The results indicated that the readabilities of the texts agree with the grade designation for use at one or two levels for each of the series, grade 2 for the Holt School Mathematics, grade 1, 4 and 6 for the series produced by Scott, Foresman and grade 4 and 5 of the Field Mathematics Program.

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Dale and Chall (1948) provide the following definition of readability.

> "In the broadest sense, readability is the sum total (including the interactions of all those elements within a given piece of printed material, that affects the success a group of readers have with it). The success is the extent to which they understand it, read it at an optimum speed and find it interesting."

Improved designs for readability formulas will place in the hands of educators powerful new tools for determining if instructional materials are suitable for use with their students. It will also help gain more insight into the comprehension processes and into the processes by which language may be more understandable. (Bormuth 1967)

Since 1940 there has been a significant increase in the number of research studies using readability formulae to assess the reading difficulty of school textbooks. (Miller 1962).

More text are read then ever before. Providing a systematic progression of graded texts is an important step in developing confidence and minimizing furstrations. (Mills 1963).

Miller (1962) stated that the readability ratings of textbooks may be of only limited significance unless the reading abilities of the various individuals who use the materials are known.

The language used in content materials should provide information about the subject area but the text must take into account the child's language deficiencies and needs.

Selecting appropriate materials and estimating the difficulty level of reading material is important to the teacher. Whatever texts are used should be within the range of the pupil's ability to read and comprehend.

The curricular materials of every field the student meets impose their own specific and unique demands upon his reading capabilities. Math word problems require an understanding of quite an assortment of technical terms. Sentences are stripped to the minimum number of words, so there is very little to suggest the meaning of a particular term in a sentence.

Some children do not comprehend math language, i.e. sentences or word problems. The reasons may be complex but one possibility may be the readability of their material. Thus a study of the readability of math text is important educationally.

Hypothesis

For the purpose of this study, it was hypothesized that the reading levels of primary math texts are on grade level while the reading levels of intermediate math texts are below grade level.

If the hypothesis is supported, students in the primary unit reading below grade level will need an individualized

program. Average or above average students in the intermediate unit may not be challenged enough and find the material dull or boring.

Specific Procedures

Mathematics texts for grades one through six published by Holt, Reinhart and Winston, Scott, Foresman and Field Education Publishers were chosen for examination as representative of material used in public schools.

The formulae by Fry and Maginnis were selected for use in this study. According to Fry, (1968) his formula correlated highly with the Dale-Chall, SRA, Flesch, and Spache Formulas.

Fry's directions when using his Graph for Estimating Readability - Extended (1977) were utilized throughout the study except as noted below. These include:
(1) Randomly select three sample passages and count out exactly 100 words each, beginning with the beginning of a sentence. Do count proper nouns, initializations, and numerals. (2) Count the number of sentences in the hundred words, estimating length of the fraction of the last sentence to the nearest one-tenth. (3) Count the total number of syllables in the 100 word passage. Average the total number of syllables and sentences in the three samples. (4) Plot on the graph the average number of sentences per hundred-words and the average number of syllables per hundre words. (5) If a great deal of variability is found in syllable count or

sentence count, putting more samples into the averageis desirable. (6) A word is defined as a group of symbols with a space on either side; thus, Joe, IRA, 1945, and & are each a word. (7) A syllable is defined as a phonetic syllable. Generally there are as many syllables as vowel sounds. For example, stopped is one syllable and wanted is two syllables. When counting syllables for numeral and initializations, count one syllable for each symbol. For example, 1945 is four syllables, IRA is three, and & is one syllable.

Magginnis (1969) extended Fry's Readability Graph thru the preprimarer level and established a formula for passages shorter than 100 words. The problem rests in a ratio which extrapolates the number of sentences or syllables which would be present if the passages did contain 100 words and if sentence length and the number of syllables per word continued at the same rate. This ratio problem may be worked by applying the following formula:

$$\frac{100S}{W} = {}^{S}100$$

S=the number of syllables or sentences in the selection
W= the number of words in the selection
$^{S}100$=the number of syllables or sentences per 100 words

For example:

Words 95
Sentences 5
Syllables 153

Substituting these figures into the formula we get:

$\frac{100(153)}{95}$ = Syllables per 100 words - 161

$\frac{100(5)}{95}$ = Sentences per 100 words = 5.3

The formulae was applied to the following books at each grade level from one through six.

Field Mathematics Program, Ricker, Isabelle etal, Field Educational Publications, Inc, Palo Alto, California, 1974.

Holt School Mathematics, Nichols, Eugene etal, Holt, Reinhart and Winston Publishers, 1978.

Mathematics Around Us, Boster, L, Carey etal, Scott, Foresman and Company, Glenview, Illinois, 1975.

In the mat texts examined lists were omitted because they were not sentences. Fractions were counted as follows:

$1\frac{1}{4}$ = one word with two syllables.

In word problems the number of the problem was not counted. For example:

1. Tom had six trucks. 1. was not counted.

Readability was examined only in the word problem itself.

Presentation and Analysis of Data

The results of the application of the formula with corrections produced the results noted in Table one.

TABLE 1

Readability Levels

Holt School Mathematics

Pupil Edition	Readability Level
1	2
2	2
3	6
4	7
5	7
6	5

Mathematics Around Us

Pupil Edition	Readability Level
1	1
2	1
3	4
4	4
5	7
6	6

Field Mathematics Program

Pupil Edition	Readability Level
1	3
2	3
3	4
4	4
5	5
6	7

The results indicates that the readabilities of the texts agree with the grade designation for use at one or two levels for each of the series, grade 2 for the Holt School Mathematics, grade 1, 4, and 6 for the series produced by Scott, Foresman, Mathematics Around Us, and grade 4 and 5 of the Field Mathematics Program. A disparity of up to 3 grades in the readability of the texts can also be noted.

Of the total of 18 books analyzed, Table II indicates that only six texts were on level while 10 were above level. At the primary level 2 books were on level while 6 were above level. At the intermeidate level 4 books are on level and 4 above level.

TABLE II

PRIMARY AND INTERMEDIATE ANALYSIS

Total books:		
On Level	Below Level	Above Level
6	2	10
Primary books:		
On Level	Below Level	Above Level
2	1	6
Intermediate books:		
On Level	Below Level	Above Level
4	1	4

These findings do not support the hypothesis in most cases and thus the hypothesis is rejected.

The data was graphed to show the similarities and differences between the material at each grade and are illustrated in Figure 1.

The graph indicates the lack of agreement between grade designation and readabilities as well as the relative position of each text at each grade level.

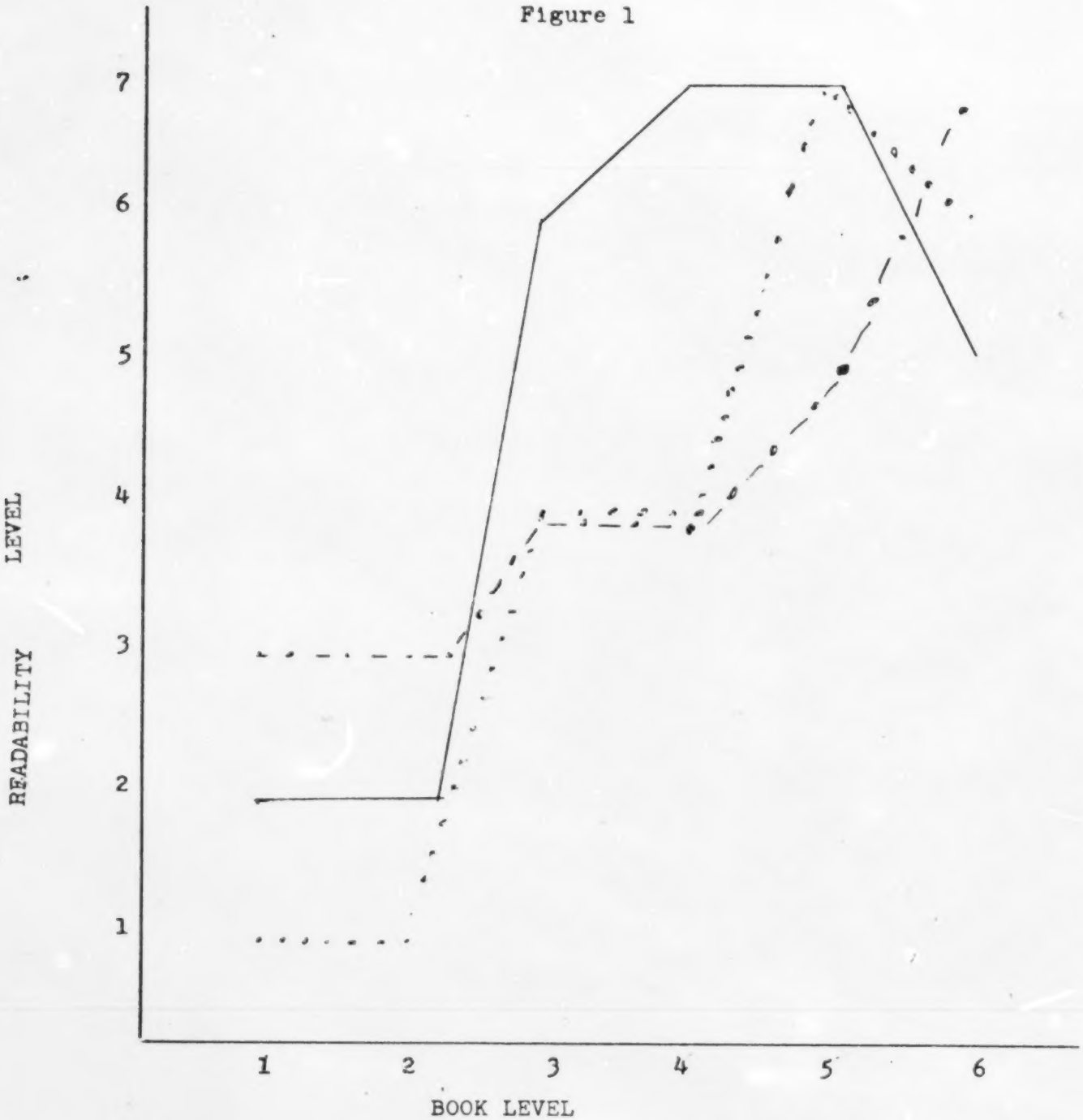
Conclusions and Implications

Based on the results of this study and within its limitations, it can be concluded that the readability levels of mathematics textbooks chosen for this study were inaccurate. Very few textbooks were appropriate for the average child. Few books were for the slow or low-achieving child. More than half the books were geared to the above average learner. None of the third grade books were on level and only one fifth grade book was on level. The other two fifth grade books had seventh grade readability levels. See Appendix A.

Differences in the readability levels of a text designated for a grade requires teachers to make adjustments to individual differences. Teachers must realize that in an average class, chances are that most of the children may have difficulty reading the textbook. Adjustments have to be made in teaching the lesson.

Teachers on selection committees for textbooks should determine the readability levels rather than rely on inspection alone. The predicated readability levels of

Figure 1



Holt School Mathematics = _____

Mathematics Around Us = ...

Field Mathematics Program = -.-.-.-.-.-.-.-.-.-.-.-.-.-.-

mathematics textbooks runs consistently higher than the performance levels of most of the students. The readability of math textbooks indicates that teachers might consistently be asking the students to perform far beyond their present ability. Persons who help choose textbooks must not ignore the importance of the readability level.

James Heddon and Kenneth Smith (1964) stated, "In selection of textbooks, be sure that three-fourths of the class can read the material with ease and understanding." If we accept this dictum, only four of the texts would be of value instructionally.

Authors and publishers of mathematics textbooks should use readability tests to assure textbooks of the proper level of reading difficulty.

The findings of Robert E. Mills and Jean R. Richardson (1963) indicated the need for publishers to use some more consistent means of grading their text. They believed that the use of comparable readability formulae was the best solution. This study concurs with their findings.

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